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Green Supply Chain Management Research: Ontological and Epistemological Issues

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Abstract. This paper emphasizes the importance of ontological and epistemological issues in doing research in the area of green supply chain management. In the context of green supply chain management, ontology guides what kind of knowledge needs to be produced whereas epistemology deals with how such knowledge can be created. If ontological issues are not taken into consideration while creating knowledge, resulting knowledge might not match the "green" aspect of supply chain management.

The oneness of ontology and epistemology will be discussed within the framework of "meaning management", a managerial concept developed by the author of this paper. In short, "meaning management" is managing the interactions of a company with its environment, business as well as natural, for improved performance through three functions: (1) cognitive function to produce a perception of environment, (2) creative function to produce value, and (3) contributive function to satisfy the needs of the stakeholders of the environment defined.

Keywords. Ontology, epistemology, meaning management, green supply chain management.

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1 Introduction

The primary objective of management research activities is to produce actionable knowledge. Research in the area of supply change management is no exception in this regard. Knowledge production however necessitates a process where two types of assumptions are to be taken into consideration: (1) ontological, and (2) epistemological. Although our objective is not to go into deep philosophical discussions, it is nevertheless important to be aware of the interplay of ontological and epistemological assumptions whence realized the oneness of the two, especially in the case of green supply chain management (GSCM henceforth.) Ontology refers to the nature of things and epistemology to the ways by which knowledge is created to understand the nature of things. In GSCM, ontological assumptions define our world of GSCM as a general knowledge framework to be understood; and epistemological assumptions and the knowledge created through them create the very reality of GSCM. In this regard, ontology guides epistemology in creating the GSCM world we have. The question here is: "Do we have an ontological base in which our epistemological action is founded?" It is difficult to claim that we have an affirmative answer to that question.

Ontological thinking means putting knowledge creation activities in its proper perspective: what is it that we would like to produce as actionable knowledge? In this paper, we shall consider ontological thinking at four levels: Level 0 – The firm; Level 1 - The immediate business environment of the firm; Level 2 – The society in which the firm operates; and Level 3 – The natural environment. See Figure 1 for ontological levels in connection with GSCM research.

A great majority of the articles on supply chain management (SCM) is concerned, albeit implicitly, with Level-0 and Level-1; that is how the firm can perform better (Level-0) in its immediate business environment (Level-1). However, there are some studies recently published that are concerned with societal (Level-2) and environmental (Level-3) issues, although very limited in number. For Level-0 and Level-1, we can cite recent articles of Shub and Stonebraker (2009), Gulati et al (2000), Hult et al (2004), Collin et al (2009), Barratt (2004), Fisher (1997), Selldin and Olhager (2007), Elmuti et al (2008) and Sun et al (2009) as some examples of the many in the literature. With respect to Level-2 and Level-3, one can mention the articles of Loch and Wu (2008) in connection with social preferences and SCM performance, Anderson and Skjoett-Larsen (2009) emphasizing corporate social responsibility in global supply chains, Eltantawy et al (2009) addressing to the issue of ethical responsibility in supply management, and Preuss (2009) discussing sustainable development through public procurement. Pursuing "what gets measured gets managed" principle, (see O'Marah and Hofman, 2009) AMR Research started "The Supply Chain Top 25" ranking of companies in terms of "operational excellence" and "innovation excellence". The most recent report puts Apple at the top, Dell as the second, Proctor & Gamble as the third.

The main objective of this paper is to suggest and discuss a conceptual framework within which ontological and epistemological assumptions regarding GSCM can be put in a meaningful perspective. As observed from the SCM and GSCM literature, epistemological objectivity has been maintained through rigorous modeling processes while an ontological subjectivity has been favored, mostly unintentionally. In fact, no philosophical attempt has been made in this respect, except perhaps some ad hoc or sporadic warnings as to the importance and urgency of environmental, societal and ethical issues. See, for instance, Stokes and Tohamy (2009) indicates 7 traits of a green supply chain for those companies who would like to define themselves as "green". The only study that really attempts to put the SCM research in a conceptual framework, to the best knowledge of the author, is due to Svensson (2007, 2009). Svensson lists, being concerned about our survival on this planet and referring to a recent UN Report titled *Climate Change 2007: The Physical Science Basis*, a set of aspects of sustainable business practices and theory. The list includes items such as corporate social responsibility, supply chain environmental management, green purchasing strategies, environmental product differentiation, reverse logistics, product returns, source reduction, recycling, material substitution, reuse of materials, waste disposal, refurbishing, repair and re-manufacturing. Svensson (2007) also indicates the importance of the concept of n-order supply chain and provides an empirical example from clothing industry and explains how it works to the benefit of all involved in the case of 2-order supply chain. This current paper will also consider such issues but from the perspective of science philosophy in general, and from the perspective of ontology and epistemology in particular.

The rest of the paper is organized as follows. The next section, Section 2, will discuss ontological issues and their implications for epistemological positioning. Section 3 will introduce the concept of *meaning management* for setting general guidelines for leadership in GSCM research. Section 4 concludes the paper with some remarks.

2 Ontological Assumptions and Epistemological Implications

Ontological assumptions are those assumptions that are instrumental in shaping or defining the nature of green supply chain system within which GSCM research is to be defined and conducted. Figure 1 depicts the levels of ontological thinking that will be considered in this paper. As can be observed from Figure 1, Level-0 concerns itself with the reality of the firm in GSCM framework; Level-1 represents the immediate business context of the firm; Level-2 concerns itself with societal issues, and finally Level-3 deals with the natural environment concerns. Each one of these levels is briefly discussed below:

Level-0: The Firm Perspective: Supply chain studies need to address the issues at the firm level with an eye on the next level. Firms need to perform well in order to maintain their existence successfully. In this respect, profitability, cost effectiveness, market share, productivity, and delivery superiority are important issues that should be taken in consideration when designing GSCM systems. A great majority of the SCM studies reported in the literature deal with these issues considerably. Ontological requirement at Level-0 is that one should define the nature of GSCM with respect to firm competiveness and performance.

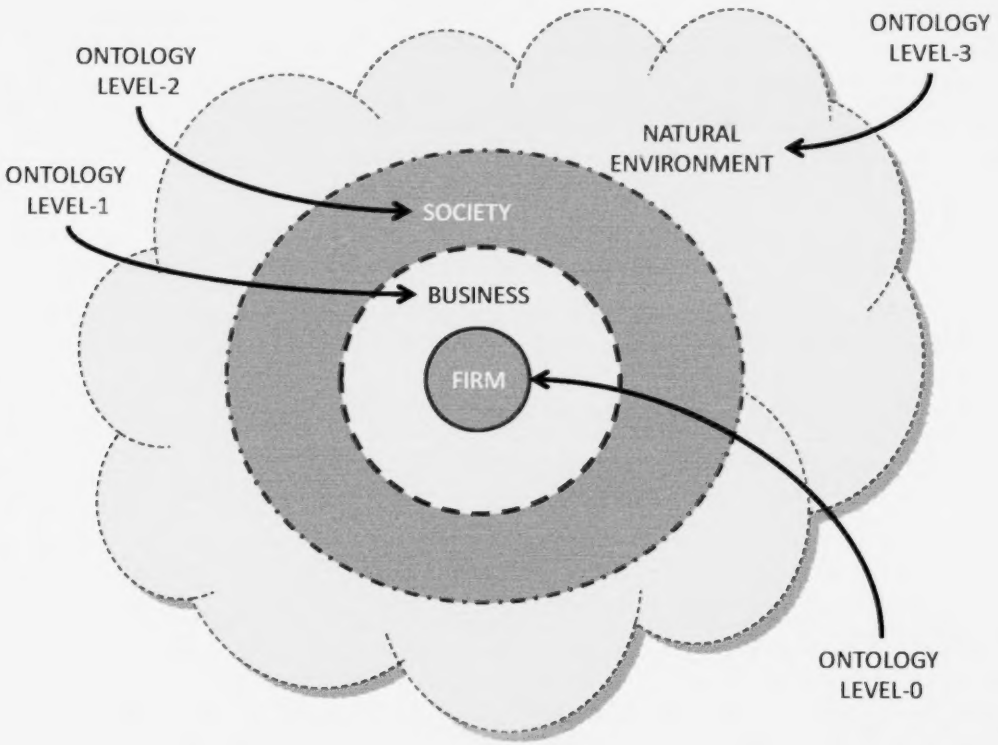

Figure 1: Ontology Levels and Green Supply Chain Management

Level-1: The Immediate Business Environment Perspective: By the very definition of SCM, the firms collaborate with their suppliers and customers to function properly in their business environment. Inbound and outbound logistics as well as the characteristics and terms of collaboration between SCM members need to be understood and designed in such a way that all participants will be in a win-win position. Fairness in terms of sought benefits to all participating member firms is essential for continued collaboration. Therefore, ontological requirement at Level-1 becomes a thorough understanding of the nature of collaborative actions beneficial to all involved within the context of global competition. Firm competition has been replaced by firm network competition in which supply chains play a considerable role. Ontology Level-1 should include Ontology Level-0 and must be within Level-2. A great majority of the articles and research papers in the literature are dedicated to the issues at Level-1. The number of articles treating SCM issues at Level-1 is in the order of thousands, if not more. See, for instance, Gattorna (2006) and Lakhal et al. (2001).

Level-2: The Society Perspective: The primary purpose of all economic activities is to bring wealth and happiness to all societies around the world by offering products and services to meet the needs of their individual members. Transparency, ethical issues, corporate governance and social responsibility are important issues to be dealt with at this level. Approval and appreciation of firm activities by societies bound the two parties together and make them a part of one another. Various stakeholders, ranging from government to NGOs, buyers to non-buyers, public authorities to trade unions, and local to international organizations, are all showing an increasing concern and interest in globalized international business (Carroll and Buchholtz, 2006). In response, companies, especially large multinational corporations, have formulated and implemented corporate social responsibility (CSR) policies and programs (Andersen and Skjoett-Larsen, 2009). Concepts like n-order supply chain systems are put into practice (Svensson, 2007). Despite many efforts to implement CSR in supply chains, a gap exists between the desirability of supply chain CSR in theory and the implementation of actual CSR in practice (Bowen et al, 2001). Therefore, it is more challenging and demanding, ontologically speaking, to deal with the pertinent issues at this level. Yet the need is out there and becoming more urgent and desirable as the time progresses (See, for instance Carter and Jennings, 2002). In this regard, ontological requirement at Level-2 becomes a comprehensive understanding of the needs and values of the societies in connection with GSCM. Similar to the case of Ontology Level-1, Ontology Level-2 should include Ontology Level-1 and must be within Level-3.

Level-3: The Natural Environment Perspective: All the resources needed for all our economic activities are obtained, directly or indirectly, from this planet of ours. The ways these resources are extracted, used, and consumed have tremendous impacts on the sustainability of our natural environment. With the increased global outsourcing activities, growing concerns about both social and environmental impacts of production and consumption have led to a more serious renewed interest in issues related to reverse logistics, environmental management, green supply chains, and sustainable supply chains (Andersen and Skjoett-Larsen, 2009). Reverse logistics as an issue has been addressed to in a number of articles and research papers, for instance, Carter and Ellram (1998) and Rogers and Tibben-Lembke (2001). Reversed supply chain – or closed-loop supply chain – is concerned with the fact that the management of returns cannot be limited to a single entity in the supply chain, but has to integrate the entire supply chain from end-users back to the original suppliers of raw materials (Andersen and Skjoett-Larsen, 2009). Green supply chains and sustainable supply chains are concepts that take a more holistic systems perspective on the total environmental impacts of the supply chain on resources and ecological footprints Van Hock, 1999; Sarkis, 2003; Preuss, 2005). It can be claimed that greening supply chains can save resources, eliminate or reduce waste, and improve efficiency and effectiveness, and eventually competitive advantage (Porter and Linde, 1995). To become more environment-friendly, greening initiatives should include some proactive GSCM design features such as high disassembling level, easiness for re-manufacturing, usability of sustainable raw materials, usability of renewable energy, usability of environmentally friendly transport modes, leading to high capacity utilization of transports systems and production facilities (Andersen and Skjoett-Larsen, 2009). Given these characteristics, ontological requirement at Level-3 suggests that one needs to understand and define the essence of GSCM issues in a much wider context and should conceptualize how GSCM systems interact with the nature in the long run as well as in the short. This requirement implies that all the previous ontology levels should be considered and defined within ontology Level-3.

Having four ontology levels described, now the task becomes how all these ontological requirements can be integrated into one so that it will be the basis of knowledge creation activities. In other words, one needs to come up with an ontological understanding, which is a more operational guide than the one described above, and that will also serve as the framework for epistemological assumptions and knowledge creation. Figure 2 is such an ontological basis for GSCM research.

In Figure 2, the green background represents the set of environmental issues one needs to identify in defining a framework for green supply chain management research (Ontology Level-3). Within this green framework there are two dynamics taking place: external dynamics of the firm that is characterized by globalization, competition, and collaboration (Ontology Level-2 and Level-1); and the internal dynamics of the firm that is defined by product management, resource management, and activity management (Ontology Level-0) to create value for the intended stakeholders through appropriate organizational structuring. The emphasis will be on "collaboration" which incorporates supply chain management intensively. In other words, Figure 2 provides guidelines as to which factors to be taken into consideration while doing research in the area of supply chain management. Let us elaborate the internal and external dynamics of the firm as indicated in Figure 2.

The process of "globalization" has been taking place, whether one favors it or not, at an increasing rate with time. Conquering time and distance with advances in logistics and information technology, hardware as well as software, it is much easier now to collaborate with partners anywhere in the world. It will be even more so in the future. Through globalization, the world is becoming flat. Friedman (2006) identifies 10 *flatteners* as forces that accelerate the process of globalization. It is a part of daily business language to talk about different types of globalization: globalization of product, globalization of market, globalization of production, globalization of capital, globalization of knowledge and technology, and even globalization of culture. Not only managers, but also GSCM researchers need to make a sense out of this globalization process. Sensemaking (Weick, 1995) at this level is essential to have a research perspective that is more comprehensive and meaningful for managers and researchers

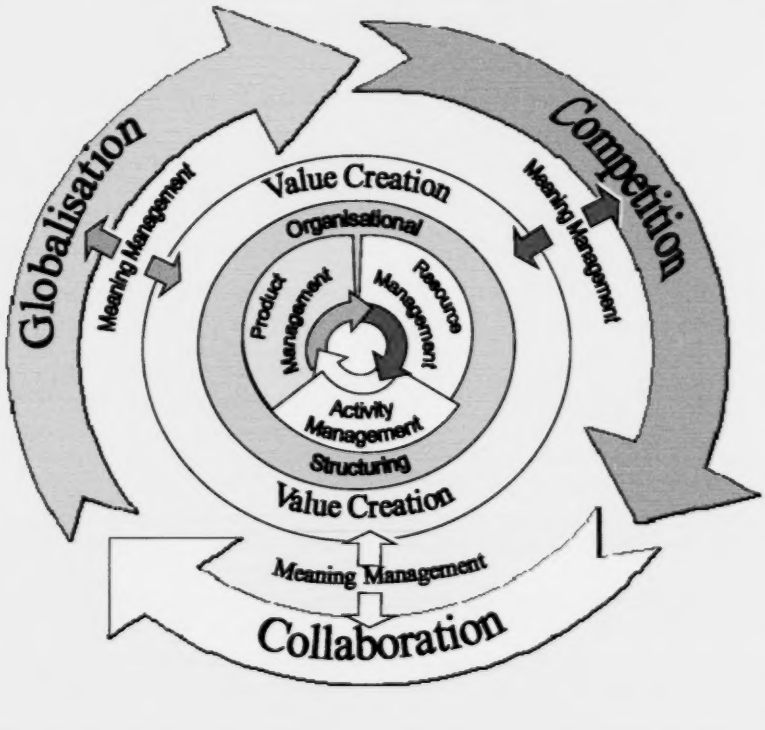

Figure 2: An Ontological Context of Green Supply Chain Management Research

alike. Having a sound perception of globalization will help GSCM researchers define their research areas more reliably in the sense that many issues are already identified through a perception formation process: which products to be produced, how to be produced and where to be marketed. Deciding on products, process, and markets will provide clues as to what to do with respect to GSCM systems (Ontology Level-2).

Globalization has changed and still is changing the nature of "competition" the companies are encountering today. Now competition is global; "any product, any place and at any time" is the rule. This rule implies that companies must obtain resources and develop capabilities to cope with this kind of global competition. For this purpose, managers must make sense out of such a global business context in order to strategically develop and activate company resources and capabilities. In this context, SCM plays an important role since it is the root of the "any product, any place, and any time" rule. Therefore, GSCM researchers must make sense out of competition in globalized context to develop their research agendas (Ontology Level-2 and Level-1).

It is now a widely practiced strategy that companies do form business alliances with other companies in order to successfully compete in a globalized business environment. "Business networking and collaboration" provides opportunity for companies to concentrate on their own core competency areas and outsource the rest from the others. Strategic decisions regarding "business networking and collaboration" include duration, terms, and areas of collaboration as well as with whom such partnerships will be formed. The book of Friedman (2005) abounds with recent examples of these kinds of business networking and collaboration. Managers and GSCM researchers must develop a sense for business networking and collaboration since such a sensemaking will be the basis of designing a more comprehensive GSCM system (Ontology Level-2 and Level-1).

As can be observed from Figure 2, firms create value through organizing their managerial activities in three main areas: (1) product management in alignment with globalization, (2) resource management in connection with competition, and (3) activity management in synergy with collaboration. These three main managerial activities define the internal dynamics of a firm whereas globalization, competition, and collaboration characterize its external dynamics. External and internal dynamics must be in harmony in order for the firms to be successful in their business environments. If the external dynamics is at a faster rate than the internal dynamics, the firm is behind what is expected of it; and if the internal dynamics is faster than its external dynamics, then it can be said that the firm is ahead of what the business world expects. Disharmonies in both directions might result in an unfavorable performance, and therefore external and internal dynamics need to be put in harmony with a "link". This link, as can be seen from Figure 2, is "meaning management."

The above paragraphs and Figure 2 indicate that managers seem to be doing different types of "meaning management" with respect to "globalization", "competition", and "business networking and collaboration" so as to form a perception of their company's "business environment" for the purposes of guiding three basic company functions: "product management", "resources management", "activity management" and accordingly to design its "organizational structuring" in order to create "value" for the intended stakeholders in the business environment they construct. In this regard, "meaning management" becomes a central issue of company management. So it is for GSCM researchers since the intent is to help managers solve their managerial problems through research in the area of supply chain design and management. In summary, Figure 2 amplifies that "meaning management" as a fundamental function of any company management. Hence the next section is on "meaning management."

3 Meaning Management and GSCM Research

A verbal definition of meaning management (Oral, 2009) is:

> *managing the interactions of a company with its business environment through a construction of business reality for the purpose of identifying managerial issues that need to be dealt with; building a critical analysis and decisional system leading to a creative generation of innovative ideas and knowledge related to the identified managerial issues; and developing channels of communication and distribution in order to have the business offerings of the company valued and favored by the intended actors of the business environment of interest.*

The definition of meaning management above, along with Figure 3, suggests three spirally interrelated and supportive functions: (1) *cognitive function* to form a perception of business environment or business reality for the company; (2) *creative function* to generate ideas and knowledge to effectively deal with the managerial issues previously identified through cognitive function; and (3) *contributive function* to form a favorable perception of the company for the business environment in order to make the company's offerings attractive and valuable to the intended actors or stakeholders. These three functions are spirally interrelated because one function follows the other, each time at a higher level, until "the perception of business environment formed by the company" sufficiently matches "the perception of the company formed by the intended actors" in the business environment of interest.

Meaning management concepts also apply to the functioning of GSCM researchers, for they need to form a perception of the contextual needs in GSCM research through "cognitive function". Once the knowledge needs identified, GSCM researchers are to produce the needed knowledge through "creative function". Dissemination and use of the created knowledge to contribute to the solutions of problems in GSCM practice is to be realized through "contributive function". Put differently, the role of meaning management is to form a perception of green supply chain management research through the cognitive function; define research areas and conduct research through the creative function; and communicate and implement research findings through contributive function. We shall discuss these concepts now in some more detail.

The Cognitive Function for GSCM Research: As can be observed from Figure 3, the output of cognitive function f is perception **P,** and is dependent on achievement **A**, information **I,** and models **M.** In the context of GSCM research, **P** is our understanding of the GSCM world, **A** is what has been done in the area of GSCM research until recently, **I** is information relieving additional GSCM research needs, and **M** denotes the mental models of GSCM researcher, his/her knowledge, experience, and preference in the area. The function f itself is the way **A, I,** and **M** are used by GSCM researcher in forming his/her research perception.

We have already defined four levels of ontology for GSCM research. They are nested in a particular way: Level-0 in Level-1, Level-1 in level-2, and Level-2 in Level-3, implying $O_0 \subset O_1 \subset O_2 \subset O_3$, where O_i is the ontology at Level-i, i=0,1,2,3. We call this property "orderly inclusive nested" sets. From the perspective of the cognitive function of meaning management, GSCM researchers need to form perceptions for each level of ontology respecting the property of orderly inclusive nested sets. Once such sets of ontology are defined, which can be considered as a method of taxonomy, they can be used in classifying the existing GSCM literature. Such taxonomy will reveal the areas of concentration of GSCM research, and more importantly the areas where GSCM research is lacking. In a sense, the cognitive function should produce a perception for GSCM research that will be useful in guiding researcher, like the periodic table once served in chemistry.

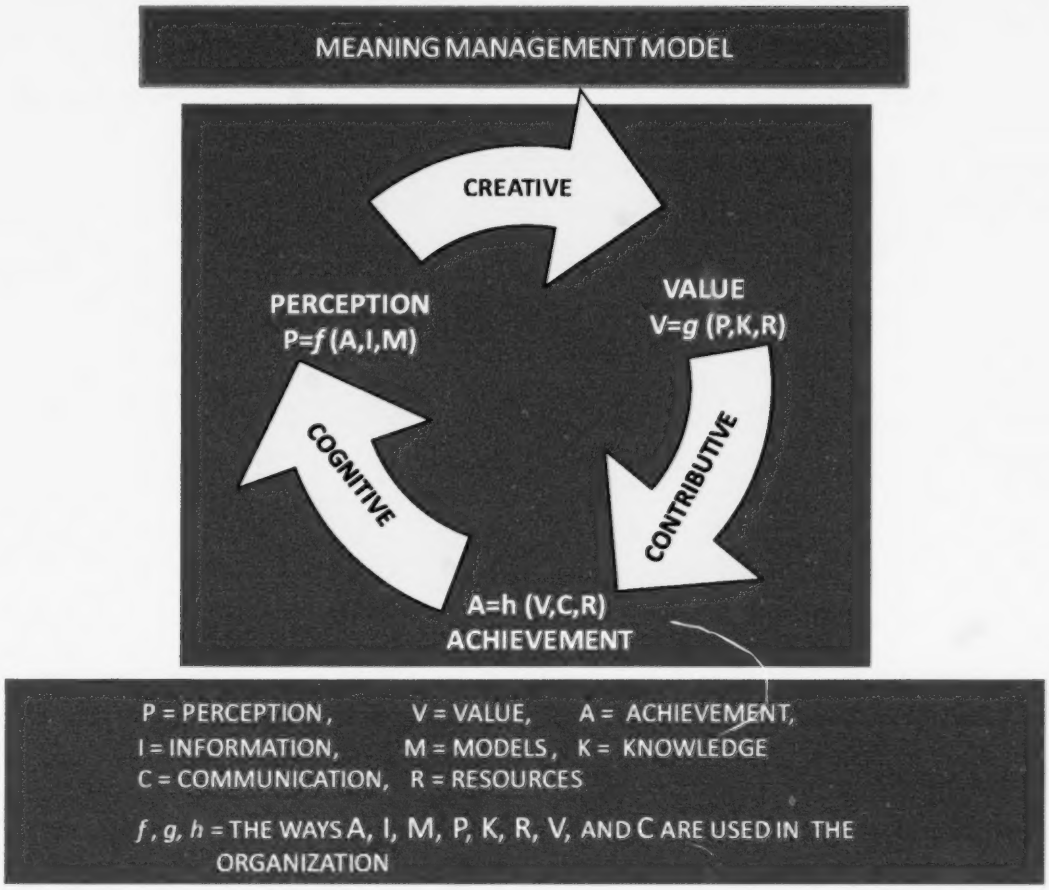
MEANING MANAGEMENT MODEL
CREATIVE
PERCEPTION
P=f (A,I,M)
VALUE
V=g (P,K,R)
COGNITIVE
CONTRIBUTIVE
A=h (V,C,R)
ACHIEVEMENT
P = PERCEPTION, V = VALUE, A = ACHIEVEMENT,
I = INFORMATION, M = MODELS, K = KNOWLEDGE
C = COMMUNICATION, R = RESOURCES
f, g, h = THE WAYS A, I, M, P, K, R, V, AND C ARE USED IN THE ORGANIZATION

Figure 3: Meaning Management and Its Three Functions

The Creative Function for GSCM Research: According to the formulations given in Figure 3, value **V** is a function ***g*** of perception **P,** produced knowledge **K,** and time and resources **R** used for this purpose. In the context of GSCM research, **V** is the value created through GSCM research, **P** is the research perception of the GSCM researcher, **K** is the knowledge created by the GSCM researcher, and **R** is the resource used by the researcher. The function ***g*** is the way **P, K,** and **R** are used by the researcher in creating **V** in GSCM.

The creative function of meaning management is constantly being used by GSCM researchers because it is the very function of theirs to offer value through knowledge creation. GSCM researchers have their own version of perception as to what to be researched and find resources for this purpose. There are many universities, institutions and research centers, and companies where the creative function of meaning management for GSCM research is put to work. CIRRELT, Interuniversity Research Center for Network Enterprise, Logistics, and Transportation in Montreal, Canada is such an example where GSCM research is taking place. In other words GSCM research community is relatively well developed in terms of the creative function of meaning management.

With respect to the orderly inclusive nested sets $O_0 \subset O_1 \subset O_2 \subset O_3$, a balance needs to be maintained between them so that a meaningful synergy is assured. As GSCM research community and our stakeholders, we should determine implied epistemological assumptions so that they will direct our research activities in connection with each ontology level. Such an exercise will help GSCM researchers identify research problems that need to be addressed to or tackled in response to each level of ontology. This exercise will also help to make a comparison of what is actually being done as research in GSCM with what needs to be done. In a sense, one can identify undone or untouched research problems or issues in GSCM.

The Contributive Function for GSCM Research: The contributive function of meaning management is associated with how well and effectively the value created through GSCM research is actually being used in practice. In a sense it deals with the achievement level of GSCM research in practice. Again, referring to Figure 3, achievement level **A** is a function **h**, where **V** is the value created by GSCM researchers, **C** is communicating the value created by GSCM researchers through publications, reports, seminars, and consulting, **R** is the resources used for "marketing" of the value created by GSCM research to the potential users.

In the field of operations research, there has been always a gap between "models constructed" and "models used" in practice (Oral and Kettani, 1993). "Why so many models are built and but so little used?" was the question to be dealt with for many decades (Landry, Malouin, Oral, 1983). This is not any better in the case of GSCM research. Bowen et al. (2001) points out the gap between the theory and practice of green supply and offers explanations. There are basically two sources that create such a gap: (1) the perception as to the needs of potential users of GSCM research is not valid, and/or (2) the producers of GSCM research lack marketing effectiveness in selling their models and research findings. In terms of meaning management, the first source is the result of an inadequate cognitive function (Type 2 error – accepting a wrong perception of GSCM world) and the second source is ineffective contributive function (Type 1 error – rejecting right contributions). It might also be quite possible that GSCM researchers produce research outputs through creative function for which there is no need (Type 3 error – solving the wrong problem). This implies that we need to perceive the GSCM world realistically and correctly, we need to produce GSCM knowledge creatively, and we need to communicate the GSCM research findings effectively.

With respect to the orderly inclusive nested sets $O_0 \subset O_1 \subset O_2 \subset O_3$, we need to formulate different selling strategies for each ontology level. One set of strategies for communicating the GSCM knowledge associated with ontology Level-0, another set of strategies for communicating the GSCM knowledge associated with ontology Level-1, and yet others for Level-2 and level-3.

6 Concluding Remarks

This paper summarized how ontological and epistemological issues of GSCM research can be put into a framework through three functions of meaning management. For this purpose, four levels of ontology were identified and explained. However, there are many tasks to be completed before having an operational set of guidelines. First, there is a need for classifying the GSCM articles until present time using a framework as summarized in this paper. Second, again using the same framework, one should identify the types of GSCM research problems and issues to be dealt with. Third, compare and contrast what is being done with what should be done and then formulate how the GSCM resources and time to be allocated. These are the challenges the author of this paper is willing to take.

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